plurality of test tubes having the same optical specifications as said sample test tube. Apparatus claims 5 and 11 are amended similarly to claim 1, and also to indicate that the plurality of test tubes are interchangeable, and to adopt the Examiner's suggestion relative to certain language in claim 5 (discussed in relation to the rejection under 35 USC §112, second paragraph). Dependent claims 4, 9, 10 and 12-14 are amended to be consistent with amended claims 1 and 5. New claims 15-19 define further features of the invention.

Applicant respectfully submits that all of the above amendments are fully supported by the original disclosure, including the original claims, and that no new matter is introduced thereby.

Additionally, applicant respectfully submits that the Examiner's rejection under 35 USC §112, second paragraph, set forth at the top of page 2 of the Office Action is overcome by the above amendment to claim 5, and accordingly it is respectfully requested that the rejection be reconsidered and withdrawn.

The above-identified Office Action has been reviewed, the references carefully considered, and the Examiner's comments carefully weighed. In view thereof, the present amendment is submitted. It is contended that by the present amendment, all bases of rejection set forth in the Office Action have been traversed and overcome. Accordingly, reconsideration and withdrawal of the rejection is respectfully requested.

**Summary of the Examiner's Position in the Office Action**

In the above-identified Office Action, the Examiner has rejected claims 1-5 and 7-14 under 35 USC §103(a) as being unpatentable over Iwamoto (US Patent 5,324,645) in light of Maggard (U.S. Patent No. 5,145,765); and has rejected claim 6 under 35 USC §103(a) as being unpatentable over Iwamoto and Maggard in light of Anderson (U.S. Patent No. 5,502,560).

**DISCUSSION**

Applicant requests reconsideration and withdrawal of the rejections, for reasons which will be outlined hereinbelow.

**Section 103 issues**

In the above-identified Office Action, the Examiner rejected claims 1-5 and 7-14 under 35 USC 103(a) as unpatentable over Iwamoto, U.S. Patent No. 5,324,945 in light of Maggard, U.S. patent 5,145,765. It is the Examiner's position that Iwamoto substantially teaches the invention as claimed except that he does not teach that his method/apparatus is useful for the analysis of liquid samples or the use of test tubes as sample cells in the analysis of liquids; that the analysis of liquid samples using near infrared spectroscopy is well known, such as taught by Maggard, so that it would have been obvious to persons of ordinary skill in the art at the time of the invention to modify Iwamoto's method/apparatus to analyze liquid samples; and that the use of test tubes is well known in the art of analysis, so that it would have been obvious to persons of ordinary skill in the art at the time of the invention to further modify Iwamoto's method/apparatus to use test tubes as sample cells for liquid samples.

Applicant's Response

Upon careful consideration and in light of the above amendments to the claims, applicant respectfully submits that the Examiner's rejection is overcome and that each of the present claims is clearly patentably distinct over the Iwamoto and Maggard references, based on the following.

Initially, applicant respectfully submits that the proposed modification - combination of Iwamoto's method/apparatus relative to select features of Maggard's method of determining aromatic content of hydrocarbons is improperly based on suggestions coming entirely from the Examiner (as guided by impermissible hindsight of applicant's disclosure), rather than from any teaching or suggestion which may be fairly gleaned from the references themselves.

Relative to the proposed modification, Iwamoto's disclosed method relates to nondestructive NIR measurements of the sugar content of *whole fruit having thick skins* (e.g., mandarin oranges, watermelon and melons), which necessarily requires determination/use of a reference wavelength at which a nearly linear relationship exists

between the size of the fruit and the NIR light absorbance thereof, and normalization of the measured absorbance at the reference wavelength. Iwamoto discusses that reference wavelengths for his method are in the shorter wavelength region (< 1000nm), e.g., the reference wavelength for mandarin oranges is 844 nm, because the radiation with such wavelengths has a comparatively strong penetrating capability.

Quite differently, although Maggard's method involves use of NIR radiation, such method specifically involves determining the aromatic content of liquid samples (hydrocarbons), and requires that the liquid sample be *standardized* prior to NIR measurement, e.g., by processing the liquid via HPLC to separate it into an aromatics fraction and a non-aromatics fraction, or by preparing known homogenous mixtures of the sample, which corresponds to the disadvantageous conventional practices discussed in the background of the present specification. Also, Maggard discusses that the preferred wavelengths used in his invention are the ranges 1650-1700nm and 2120-2256nm.

Given the specific teachings of the references, persons of ordinary skill in the art would not consider it obvious to (generally) use the method of Iwamoto to measure physical properties of liquids, as proposed by the Examiner, because the references provide no motivation or reason for doing so. Each of the references discloses a method which is specifically suited to measurement of a specific characteristic of a given matter (whole fruit with thick skins or hydrocarbons having an aromatics content), and there is no indication by either reference that the method disclosed therein could be used to measure a different characteristic of a completely different material.

Moreover, applicant respectfully submits that even if the teachings of Iwamoto and Maggard were somehow hypothetically combined, any combination resulting from the full fair disclosures of these references would not achieve the invention as defined by any of the present claims, nor would any such combination achieve the advantages which are achieved by the present invention.

For example, claim 1 has been amended in order to more clearly identify the subject matter thereof. In its present form, claim 1 makes it clear that multiple object characteristics

of the liquid are determined in the method thereof. Similarly, claim 5 is amended to define that object characteristics of the liquid are computed. This is different from the teaching of Iwamoto, in which only a single object characteristic, the sugar content of fruit, is measured, and from the teaching of Maggard in which only the aromatic content of hydrocarbon liquid samples.

Further, claim 1 now explicitly claims that the referenced **calibration equation is made from a near infrared absorption spectrum of a liquid reference sample with known object characteristics, which liquid reference sample is disposed within a plurality of test tubes having the same specification as said sample test tube**. Claim 5 has also been amended to require that a plurality of interchangeable test tubes with the same specifications be used as part of the apparatus.

In contrast, none of the cited references teach or suggest using test tubes, having substantially the same optical characteristics as one another, to house both the test sample and a plurality of reference samples. Again, Iwamoto's method/apparatus is not used in relation to liquid samples and does not use a sample cell or a test tube. On the other hand, Maggard discloses a special flow-through cell as discussed at his col. 3, lines 42-49.

Applicant respectfully submits that this distinction is very important as a practical matter. Even though using a special cell to house a given sample is effective, and allows for a very accurate calibration equation, the calibration effected using a plurality of interchangeable test tubes with the same specification (the difference in absorbance can be compensated) can achieve a useful and substantially accurate analysis. If the special cell is broken by accident, then time, labor and added expense are required to adjust the calibration equation to a new cell for continuing an analysis. Also, as a practical matter, the special cell cannot be used in an agricultural or factory environment because there are many sample objects to be analyzed in such an environment. Since the apparatus according to the present invention uses a plurality of interchangeable (ordinary, inexpensive) test tubes, a broken test tube can be quickly and easily replaced without need for recalibration, and the apparatus can

be efficiently used for quick analyses of liquids in an agricultural or factory environment, where such type of analysis is required. See page 9 of the present specification.

Still further, applicant respectfully submits that the applied references do not disclose or suggest other features set forth in the claims, including: the use of NIR light having a wavelength of 700-1100 relative to liquid samples as defined in claim 2, noting that Iwamoto uses a reference wavelength specific to the whole fruit being analyzed, while Maggard uses preferred wavelengths of > 1600nm; the use of a plurality of ordinary test tubes for containing the sample liquid and the liquid reference sample during measurements as defined in claims 4, 10 and 14; etc.

In this regard, applicant has considered the Examiner's assertions made in support of the rejection, but it is respectfully submitted that such allegations are not supported by the teachings of the references or by any other evidence of record. For example, while Maggard teaches the use of NIR measurements for determining the amount of aromatics in hydrocarbons, he does not generally teach the use of NIR measurements as useful for any liquid. Further, it is not conventional to use ordinary test tubes for making NIR measurements, but rather use of special sample cells is conventional, as discussed in the background of the present specification. Thus, while test tubes may be known, it is never shown to be obvious to use same in making NIR measurements on a liquid sample and on reference liquid samples as claimed, whereas this feature is very advantageous as discussed above.

Based on the foregoing, applicant respectfully submits that the rejection of claims 1-5 and 7-14 under 35 USC 103(a) as unpatentable over Iwamoto in light of Maggard is overcome, and accordingly it is respectfully requested that such rejection be reconsidered and withdrawn.

Further in the above-identified Office Action, the Examiner rejected claim 6 as unpatentable over Iwamoto and Maggard in light of Anderson, U.S. patent 5,502,560. It is the Examiner's position that while Iwamoto does not disclose the use of a white light source as a light source and the use of a diode array as an optical sensor, it would have been obvious to a

person of ordinary skill in the art to include such features in Iwamoto's apparatus based on the teachings of Anderson.

Upon careful consideration and (again) in view of the above amendments to the claims, applicant respectfully submits that such rejection is overcome and that claim 6 is clearly patentably distinct over the applied references based on the foregoing arguments concerning the merits of claim 5 (which are not overcome by any additional teaching of Anderson).

Accordingly, applicant respectfully requests reconsideration and withdrawal of the Examiner's rejection of claim 6 under 35 USC §103(a) as being unpatentable over Iwamoto and Maggard in light of Anderson.

New claims 15-19 are believed to be allowable over the references of record based on the foregoing arguments concerning the merits of claims 1 and 5, as well as on the merits of the additional features set forth in these new claims.

Conclusion

Applicant respectfully suggests that none of the references of record, considered either singly or in any combination, teach applicant's invention, as presently claimed, and that further, skill generally available in the art would not lead to a person of ordinary skill to create applicant's claimed invention, using the references of record.

Applicant respectfully suggests that as presently amended, all of the pending claims are believed to be allowable, and a notice to this effect is earnestly solicited.

No new matter has been added by the present amendment, as all the material herein was expressly or inherently disclosed in the application as originally filed.

For all of the above mentioned reasons, applicant requests reconsideration and withdrawal of the rejection of record, and allowance of all the pending claims.

Applicant is filing a Petition For One Month Extension herewith.

Respectfully submitted,

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**CERTIFICATE OF TRANSMISSION**

I hereby certify that this correspondence is being submitted via facsimile transmission to the US Patent & Trademark Office, Art Unit 2878, on September 30, 2002.

Kathryn MacKenzie

MARKED UP VERSION TO SHOW CHANGES MADE TO CLAIMS

1. (Twice Amended) An analytical method for analyzing a liquid sample using near infrared spectroscopy comprising the steps of:

(a) applying near infrared light in a short wavelength range to the liquid sample as disposed within a sample ~~cell~~ test tube from outside the sample ~~cell~~ test tube;

(b) detecting at least one of diffusely ~~scattered or~~ reflected light ~~and~~ diffusely transmitted light, and transmitted and reflected light from the liquid sample by an optical sensor to measure a near infrared absorption spectrum of the liquid sample; and

(c) ~~modifying~~ comparing the measured spectrum value to a value obtained from ~~using~~ a calibration equation which has been determined in advance ~~from a spectrum measured using the steps (a), (b) relative to liquids with known object characteristics~~, thereby determining ~~an~~ object characteristics of the liquid sample.

~~wherein said calibration equation is determined from a near infrared absorption spectrum of a liquid reference sample with known object characteristics, which liquid reference sample is disposed within a plurality of test tubes having the same optical specifications as said sample test tube.~~

4. (Twice Amended) The analytical method for analyzing a liquid sample using near infrared spectroscopy according to claim 1, wherein a plurality of ordinary test tubes with substantially the same optical specifications are used interchangeably as the ~~sample cell~~ test tubes in the spectrum measurement of the [liquids with known object characteristics for] reference sample in determining the calibration equation.

5. (Twice Amended) An analytical apparatus for analyzing a liquid sample comprising:

a plurality of interchangeable ~~sample cell~~ test tubes;

a block provided with a housing portion [for] which receives one of said ~~the sample cell~~ test tubes containing the liquid sample therein;

a near infrared apparatus provided with a spectroscope for dispersing near infrared light in a short wavelength range ~~from light~~ from a source of light or the sample and an optical sensor for detecting the near infrared light;

light conduction means for conducting the dispersed near infrared light to the ~~sample cell~~ test tube within the housing portion and for conducting, directly or through the spectroscope, at least one of diffusely reflected light [and], diffusely transmitted light, and transmitted and reflected light from the liquid sample within the ~~sample cell~~ test tube to the optical sensor; and

control means for outputting a measurement command of a spectrum to the near infrared apparatus and for modifying the measured spectrum using a calibration equation which has been determined in advance, for thereby computing an object characteristics of the liquid sample.

9. (Twice Amended) The analytical apparatus for analyzing a liquid sample according to claim 5, wherein the block is provided with a temperature control means for stabilizing the liquid sample within the [sample] ~~cell~~ test tube at a predetermined temperature.

10. (Amended) The analytical apparatus for analyzing a liquid sample according to claim 5, wherein the [sample cell is an] test tubes are ordinary test tubes

11. (Amended) The analytical apparatus for analyzing a liquid sample according to claim 5, wherein said calibration equation is determined in advance from a near infrared spectrum measured by the analytical apparatus using [liquids] a liquid reference sample with known object characteristics, and with the liquid reference sample disposed in a plurality of the test tubes.

12. (Amended) The analytical apparatus for analyzing a liquid sample according to claim 11, wherein ordinary test tubes with the same specifications are used as the [sample ~~cell~~] test tubes

in the spectrum measurement of the [liquids with known object characteristics for determining the calibration equation] liquid reference sample.

14. (Amended) The analytical method for analyzing a liquid sample using near infrared spectroscopy according to claim 1, wherein the sample [cell is] test tube and the plurality of test tubes having the same optical specifications as the sample test tube are ordinary test tubes.